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Validation for Flaw Acceptance of Mechanical Damage to Low Stress Natural Gas Pipelines

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Project Objectives

The objective of this research is to develop flaw acceptance criteria to provide safe alternative options to the repairs of mechanical damage on gas pipelines operating at stress levels below 40% of the Specified Minimum Yield Strength (SMYS).

The results will provide field protocols and guidelines for use by personnel to decide whether the encountered damage warrants repair or not; thus increasing the safety of the operation at these stress levels and potentially saving costs associated with repairs that are normally applied to highly stressed pipelines (over 40% SMYS).

The proposed research includes performing tests at various damage levels to provide the confidence needed for establishing the repair/no repair criterion. The results will be implemented in a selected model and procedure. The recommendations will be proposed to the appropriate standard development organizations (e.g. ASME, ASTM, etc.) for consideration as an industry standard.

Technical Progress and Results

- Started work on establishing the testing parameters for the validation of the flaw acceptance criteria. The results of the testing program will be used to increase the confidence of the selected model: EPRG Simplified Model.

Since a large number of tests are needed to address the various pipe types and damage sizes, work in this task will optimize the range of pipe and damage characteristics. The testing parameters include pipe diameters from 8 to 16 inches with D/t ratios up to 64. These tests will account for the increased likelihood of re-rounding in larger D/t ratios and thus the development of re-rounding cracks on the larger pipes. These re-rounding cracks, which are not always detected by visual examination, can weaken the strength of the pipe, reducing the effective minimum safe wall thickness and ultimately, causing a pipeline failure.

One of the key parameters that determine the subsequent growth and failure of the pipe during these tests is the pipe's toughness. For this reason, a portion of the test matrix includes low toughness pipe to ensure the model is valid over the whole range of pipe grades.

Most of the previous mechanical damage testing has been based on machined notches applied to the pipe before or after the denting process. This approach allows for good control of the gouge and dent depths but may not capture all of the features of true mechanical damage. In order to capture possible developments of crack during re-rounding, the denting process will be performed on pressurized pipe. A portion of the tests will also be performed using a simulated backhoe to model field conditions.

A meeting with the project consultant (Kiefner & Associates) was performed to discuss initial plan for the testing matrix. The meeting addressed the testing parameters which include the following:

- Pipe grade
- Pipe size (d/t)
- Pipe material toughness
- Damage type (gouge & Dent)
- Damage size (gouge angle, length, width)
- Field simulation of backhoe damage

- The hydraulic system used to apply damage was modified to accommodate the application of gouges and dents on large size pipes (up to 24 inch diameter).

- Designed and assembled a new hydraulic system to allow for applying hydrostatic pressure up to 6,000 psig for rupture tests.

Plans for Future Activity

- Complete modifying the mechanical system to apply damage, based on the selected parameters in the test matrix.
- Continue work on establishing the testing parameters based on the previous model verification tests.
- Start the testing program. Apply controlled gouges and dents on the first set of pipes.

Respectfully Submitted,

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